Using Additive Manufacturing to Reduce the Cost of Instrument Development

Completed Technology Project (2017 - 2018)

Project Introduction

Additive Manufacturing (AM), commonly known as 3D printing, is widely used in the commercial sector for the manufacture of consumer goods, high performance parts for custom applications, and aerospace parts. Goddard Space Flight Center has used AM only sparingly. For AM to be used effectively a new design, manufacture, and testing process is needed that will reduce scientific instrument development costs, exploit the inherent advantages of AM while accommodating the disadvantages.

Anticipated Benefits

In the standard Goddard instrument development process, to assemble two parts of the instrument, say Part A and Part B, into an Assembly AB, twelve documents are required

Parts are manufactured by initiating WOAs that reference design drawings, then all parts are inspected, cleaned, and stored prior to assembly. Each of these steps requires documentation of the procedure. These documents require preparation, signoff by the senior members of the instrument team, and configuration control.

With AM complex parts can be made, even parts too complex to be machined. Mass lightened parts that are difficult to machine can be easily printed. AM interfaces well with the 3D modeling capabilities that GSFC which GSFC has invested heavily over the last 15 years, and finally AM provides for rapid, inexpensive prototyping in plastic or metals, including aluminum.

In addition, AM allows for the possibility of Topological Optimization (TO), or computer optimized parts design, which tends to produce organic looking parts that are difficult to machine, but easily printed (Figure 3). Topological Optimization integrated with NASTRAN will allow the design of lower mass instruments.

The three identical parts, shown in this picture were 3D printed from the 3D CAD model of the original machined part.

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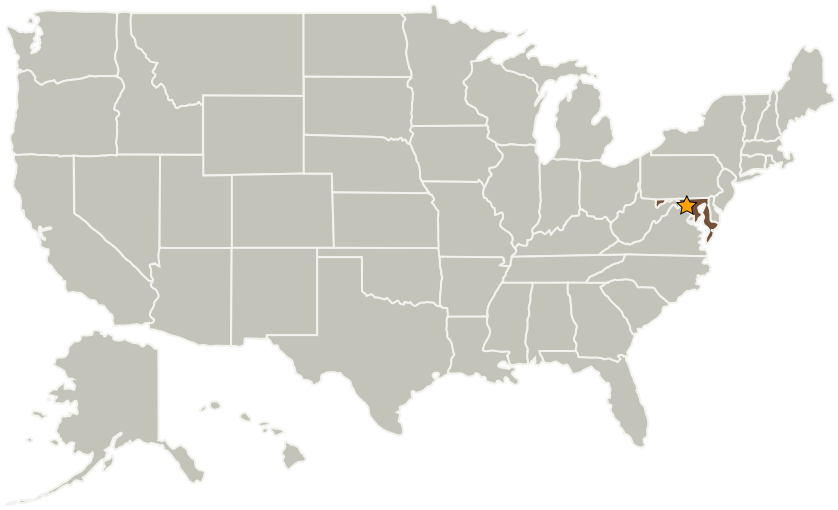
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Nikolaos Paschalidis
Michael A Johnson

Principal Investigator:

Joseph M Davila

Co-Investigators:

Charles D Butler
James P Haas
Nicholeen M Viall-kepko
Michael J Viens
John A Crow

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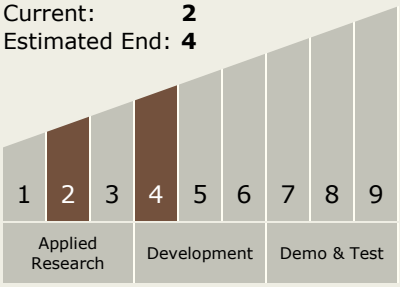
Images

An original part from the STEREO/COR1 coronagraph shown in machined and 3D printer forms.
The three identical parts, shown in this picture were 3D printed from the 3D CAD model of the original machined part.
(https://techport.nasa.gov/image/28202)

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.2 Intelligent Integrated Manufacturing

Target Destinations

The Moon, The Sun, Earth

Supported Mission Type

Projected Mission (Pull)